ON THE HYDRO-ECOLOGICAL CHARACTER OF THE LAKE OF A GRAVEL-PIT

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Introduction and the purpose of the examinations

There are numerous barrow- and gravel-pits in Hungary, and in several respects we are still in arrears with their investigation. Even at the first glance they obviously differ from the majority of Hungarian waters. These less studied small waters raise numerous limnological problems, the solution of which would be greatly promoted by their hydrobiological investigation.

This is supported by their place in V a r g a's (1954) lake classification system, according to which they belong in general with the "*kopolya*" type of waters.

In Hungary only S c h i e f n e r – F á z o l d – O r m a y (1966) did biological examinations in public hygienic respect on the Mály lake of similar origin and situated near the site of our investigations.

After such premises in August 1972 we got an opportunity of conducting biological investigations in one of the lakes at the Nyékládháza gravel-pit.

On account of our limited possibilities, we could only strive

- to determine the morphology of the lake
- to fix some hydrochemical indices
- to plot the map of the weed fields of the lake, and
- to collect data on the macrofauna living in the weed-grown parts of the lake, regarding both quality and quantity.

Acknowledgement

We owe sincere thanks to the "*Triton*" light divers' group directed by Mr. O. B o j t á r for their competent work in mapping the weed fields and in biological sampling.

Place, time and method of the examinations

The site of the examinations was the so-called „Középső-tó"(Middle Lake) situated to the north of Nyékládháza (Borsod-Abauj-Zemplén County, Northern Hungary) along the railway line to Miskolc, in the vicinity of the Mály lake.

The soundings of depth hydrochemical analysis, botanical mapping as well as the examination of the macrofauna were performed between 9—15th August, 1972.

With a view to obtain information on the morphological character of the lake, founded on soundings at every 2 metres along cross pr ofiles taken at every 10 metres, we drew its depth map.

Out of the methods current in the practice of hydrochemistry, pH- and conductivity we determined by the electrometric methods, the examinations of solved oxygen we performed according to Winkler's method. Water samples were taken in all 13 occasions, near the surface.

So that the exact location of the macrovegetation could be fixed, we plotted relying on a base map on the scale of 1 : 25.000 meters the map of the weed fields of the lake.

Following the botanical survey we took zoological samples from the weed fields on twenty-six occasions in all. The essence of the procedure consisted in the following: a plastic cylinder of 6 m. in length and of 0.14 m^2 ground surface was let above the stands of plants. Reaching into the cylinder at the boundary of sediment and water, we took out the entire mass of plants. Having bound up the upper and lower moundings of the cylinder, we washed the animal matter off the plants and filtered it through a net with 0.5 mm. wide meshes. Eventually, the washed-out zoological material was stored in 4% formalin solution, and upon identification, counting and drying at 60° C, the dry weight of the most important orders and species of the macrofauna was taken.

The results of the investigations and their assessment

A) *About the morphological character of the lake*

In August 1972 the maximum depth of the lake was 6.8 m., its average depth being about 5 m. The most part of the bottom was covered with fine-grained sand and gravel, as well as in one spot with clay (Fig. 1. and 2.).

B) *About the hydrochemical conditions*

Relying on the data measured at 13 surface spots of the lake, we found the following average values:

Table I.

Summary of the hydrochemical results

Hydrochemical indices	Average
pH	7.70
conductivity (uS)	537
solved O_2 (mg/l)	7.84

The values of pH and conductivity were identical in every instance, the solved oxygen content differed only by 0.1% from the average value. Consequently, the data indicate considerable hydrochemical uniformity. Schiefner – Fázold – Ormay (1966) got similar hydrochemical results in the Mály lake situated likewise in the area of the gravel-pit.

C) *Results yielded by the mapping of weeds and by zoological examination*

As shown by the weed map, the two predominant plant species in the lake are *Myriophyllum spicatum* and *Ceratophyllum submersum*. It is the homogeneous stands of the latter that have stretched towards the deeper parts.

The comparison of Fig. 1. and 2. leads one to the conclusion that also the grain size at the bottom of the lake has an important part.

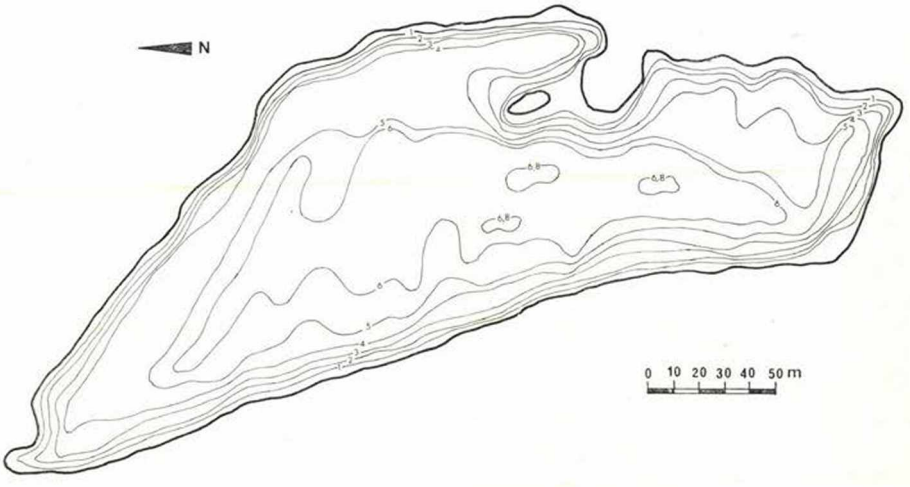

Fig. 1. Depth map of the examined area

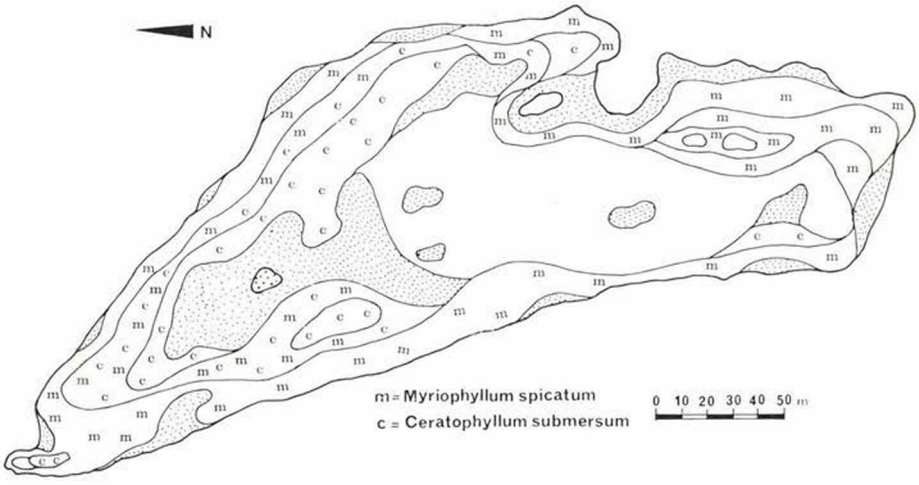

Fig. 2. Weed map of the examined area. Not dotted = sand, dotted = gravel, + = clay.

Table II.

Average Biomass of Macroorganisms in Myriophyllum spicatium

Taxa	Avg No. per sq m	Avg DWt per sq m	Avg No per kg DPWt	Avg DWt per kg DPWt
Hirudinoidea				
Piscicola geometra L.	7	0.0336	101.3	0.4862
Mollusca				
Limnea peregra Müll.	49	0.4158	709.1	6.0173
Ephemeroptera				
Cloeon dipterum L.	7	0.0014	101.3	0.0202
Caenis sp.	35	0.0077	506.5	0.1114
Trichoptera				
Echnomus tenellus Klap.	28	0.0056	405.2	0.0810
Cyrnus (flavidus Mac. Lach.?)	7	0.0035	101.3	0.0506
Lepidoptera				
Acentropus niveus Oliv.	56	0.0140	810.4	0.2026
Diptera				
Chironomidae	112	0.0098	1620.8	0.1418
Hydracarina				
Piona pusilla Neum.	28	0.0049	405.2	0.0709
Total	329	0.4963	4355.9	7.1920

Abbreviations: DWt = g dry weight
DPWt = Dry plant weight

The average biomass of *Myriophyllum spicatum* measured in air dried condition amounted to 69.1 g/m², that of *Ceratophyllum submersum* to 36.0 g/m². The detailed results of the collection of macrofauna performed in the stands of *Myriophyllum spicatum* are summarized in Table II. According to these results the average biomass of the macrofauna was 0.4963 g/m² in the stands of *Myrophyllum spicatum*. This value corresponds to 7.0422 g. animal weight per 1 kg. dry plant weight. We remark here that in the data about the weight of the *Mollusca* and *Lepidoptera* groups also shells of the animals are included.

Table III.

Average Biomass of Macroorganisms in Ceratophyllum submersum

Taxa	Avg No. per sq m	Avg DWt per sq m	Avg No. per kg D P Wt	Avg D Wt per kg D P Wt
Ephemeroptera				
Caenis sp.	42	0.0028	1166.6	0.0777
Trichoptera				
Echnomus tenellus Klap.	42	0.0056	1166.6	0.1555
Cyrnus (flavidus Mac Lach)?	7	0.0042	194.4	0.1166
Heteroptera				
Micronecta sp. lárvae	7	0.0007	194.4	0.0194
Diptera				
Chironomidae	56	0.0035	1555.5	0.9722
Total	154	0.0168	4277.5	1.3414

Abbreviations: DWt = g dry weight
DPWt = Dry plant weight

A detailed summary of the results of the macrofauna collection conducted in the stands of *Ceratophyllum submersum* is presented in Table III. Relying upon it, the average biomass of the macrofauna was 0.0168 g/m². This value corresponds to 1.3414 g. animal weight per 1 kg. dry plant weight.

The macrofauna of the *Myriophyllum spicatum* stands of rather near-shore location was more varied in quality and greater in quantity.

Let us now consider, how the data presented here can be related to results of similar examinations conducted in other Hungarian waters. Comparison is rendered difficult by the circumstance that few accurate quantitative surveys took place up to the present, and not even the small number of data at hand can be referred to a given lake, – at best to a hydrochemical area. In spite of these limits, a collation of the data presented in the following Table seems instructive.

Table IV.

Informative data about the quantity of the macrofauna in the weed fields of various lakes

Lakes	Fertő		Lake Velence		Nyékládháza Middle Lake	
Weed species	Utricularia vulgaris	Myrio-phyllum spicatum	Utricularia vulgaris	Myrio-phyllum spicatum	Myrio-phyllum spicatum	Cerato-phyllum submersum
Biomass of weed species g/m²	240.0*	126.8*	158.4	325.0	69.1	36.0
Macrofauna No./m²	5024.5+	1838.5+	4000	2160	329	154

* = Data published by I. Kárpáti et al.
\+ = Andrikovics (1973/a)
Data about Lake Velence = Andrikovics (1973/b)

Accordingly, the biomass of the weed and the quantitative data of the macrofauna as measured in Lakes Fertő and Velence amount to the manifold of the similar values concerning the approx. 35 years old so-called „Középső-tó" (Middle Lake) near Nyékládháza. On the other hand, it also appears that the expressed zoocenological heterogenetity bound to plant species in Lakes Fertő, Velence and Balaton can be demonstrated even in a hydrochemically quite uniform, deeper lake.

Summary

The author conducted hydrobiological research in a lake of a gravel-pit in Northern Hungary. In the „kopolya" type of water which has been studied but to a lesser degree up to now in limnological respect – Varga (1954) – the following examinations were performed:

The depth-, bottom- and weed maps of the lake were plotted (Fig. 1. and 2.). With a view to determining the *macrofauna* biomass of the lake, also zoological samples were taken. Finally, the author compared his findings with similar zoological data about other Hungarian waters.

There are two dominant plant species to be found in the lake: *Myriophyllum spicatom* and *Ceratophyllum submersum*. The macrofauna living on the stands of *Myriophyllum spicatum* growing near the shore was found it be much more abundant than on those of *Ceratophyllum submersum*. In Tables I. and II. zoological data are presented in detail.

Relying upon the examination, the author could find that – at homogeneous hydrochemical conditions – the heterogeneity of the shallow lakes of Hungary involving so-to-say all hydrobiological factors could also be demonstrated in the examined lake, even if only to a smaller degree.

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